

Mycotoxin binders – careful selection for ensured safety

Mycotoxins are a global problem in diets for ruminants, present in a wide range of feed ingredients as well as conserved forages. The toxins are produced by moulds on feed both pre- and post-harvest and can impact the health and performance of livestock. Even in ideal feed storage conditions, mycotoxins may still be present and pose a risk.

by David Wilde,
Anpario plc, UK.
www.anpario.com

Where mycotoxins are present in feeds, their impact can be reduced by the addition of mycotoxin binders. The most widely used mycotoxin binders contain clays and yeast cell walls.

There are many different products commercially available, all with numerous claims and studies demonstrating their efficacy in binding toxins in vitro as well as in vivo, making the choice of the most suitable binder difficult at best, and confusing at worst.

All products work by simple adsorption of the mycotoxins onto sites on the binders, thus allowing the toxins to pass through the animal without causing problems. Some products, in addition to simple adsorption, have a more complex mode of action, including the biotransformation of certain mycotoxins into less harmful secondary metabolites by the use of enzymes or bacteria. To date, only one enzyme and one bacterium are approved by the EU for the biotransformation of tricothecene mycotoxins and then only approved for use in pigs and poultry, as the data submitted to the EU for approval was for those species only, thus prohibiting its use in ruminants.

Understanding clay

Of the more common binders, clays have received a great deal of attention. Geophagy is the practice of animals in the wild consuming clay as an aid to reducing digestive upsets. This observation led to the use of clays as mycotoxin binders in feeds.

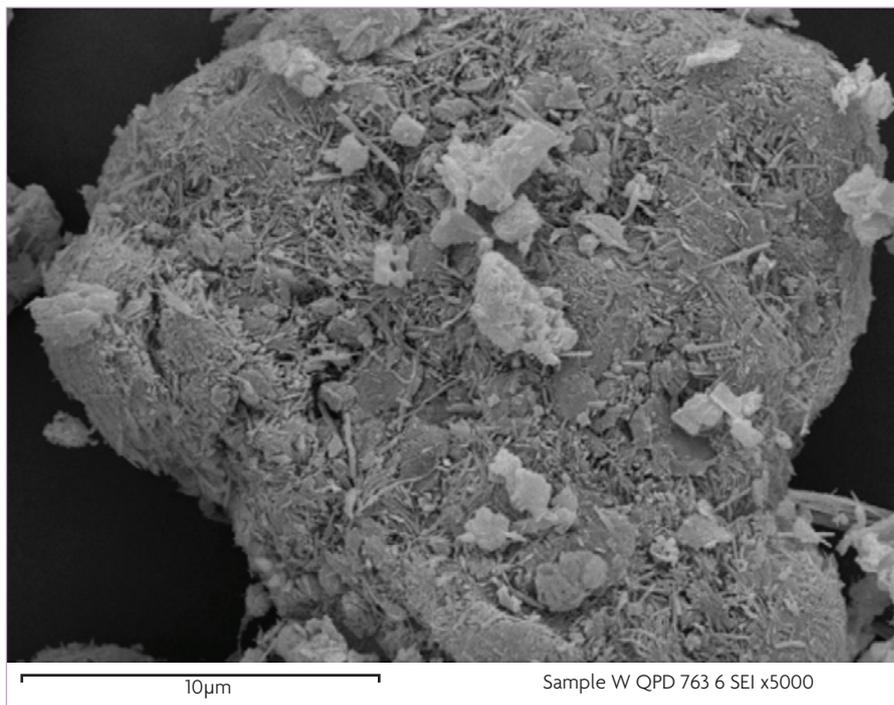


Fig. 1. Scanning electron microscope image of a particle of sepiolite.

Clays are also used industrially in water treatment and purification. The ability of certain clay materials to remove excess heavy metals from water has been long established.

Clays were laid down millennia ago, the result of primarily volcanic activity and the resultant ash or sedimentation. This results in very different structures and properties of individual clays, with large variations seen between different geographic regions around the world.

Clays are classified according to their chemistry and physical properties. All clays contain silica, aluminium, magnesium, sodium, potassium and iron, in very differing amounts. The variation in chemical composition leads to the very different properties. The common usage of the blanket term 'clay' is not helpful in distinguishing between their differing effectiveness.

Some of the better known clays are classified as bentonites, sepiolites, zeolites, montmorillonites, smectites or hydrated sodium calcium alumina silicates (HSCAS).

Clays also differ in physical structure. Some have a layered structure, for example bentonites, whilst others, such as sepiolites, have a more crystalline structure (Fig. 1).

The structure of the clay affects the binding ability, not just of toxins but also of other chemicals due to the cation-exchange capacity of the clays. Each one is different depending upon structure and mineral content of the clay.

For example, the layered clays can bind many other micronutrients, such as minerals and some antibiotics, so their use can be limited. At an extreme, bentonite is contraindicated for the co-administration of decoquinate, often used in ruminant diets to prevent coccidiosis.

Clays within an individual class can also have different efficacies, due to the differences in their chemical composition. A specific bentonite product from a certain geographic area, has recently received European authorisation as a mycotoxin adsorbent for its ability to adsorb aflatoxin B1. However, a recent opinion on a range of

Continued on page 9

Continued from page 7

different bentonite products, submitted in a single application by six members of the European Bentonite Association, concluded that there was insufficient evidence of efficacy in vivo for each of the differing products to receive a blanket authorisation for binding aflatoxin B1. So every product (regardless of class) will potentially have to be the subject of an individual application. Furthermore, the term bentonite has been brought into question as being too general.

Yeast cell walls (YCW) are commonly used for endotoxin and general binding of pathogens in the gastrointestinal tract but, as with clays, the source and quality play an important role in the ability of YCW to bind.

The site of adsorption in YCW are glucans and mannans, and their content is affected by both the strain of yeast and the production process to which the yeast is subjected. Brewers' yeast, which is a common source for YCW on the market, can have a very low glucan content, thus reducing its effectiveness.

Application rate

Commercially, mycotoxin binders are usually advised to be fed at a standard level, but in severe challenges it is a common tactic to increase the inclusion

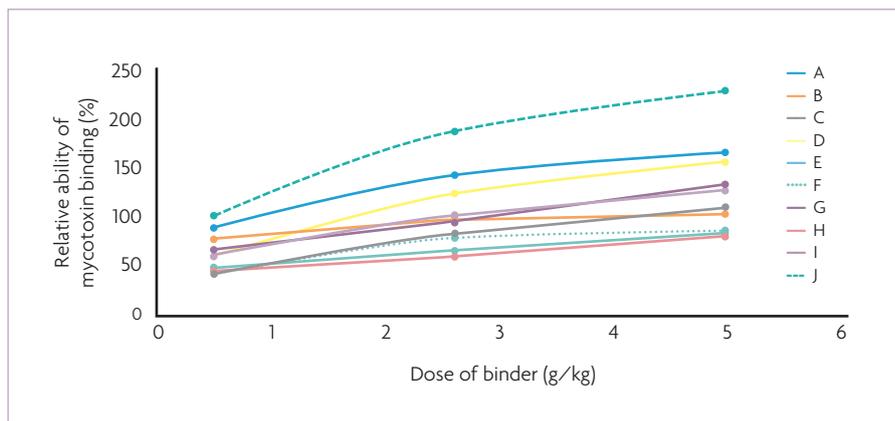


Fig. 2. Relative ability of various binders at pH6.5 to bind mycotoxins.

rate to obtain a greater degree of binding, working on the theory of a linear response. In practice, there is a curvilinear effect, which is dependent upon the dose of mycotoxin used in the study and the amount of free surface area in the binder to effectively adsorb the toxins. Therefore comparisons between studies are difficult as each study will use different doses and analytical methodologies.

Recent work, undertaken by Anpario at an independent laboratory, has demonstrated the in vitro efficacy of various commercial binders, adsorbents and biotransformers including both clay and YCW products.

These tests were carried out at different pH levels, designed to reflect ruminant and mono-gastric digestive tracts, and binder concentration to assess the dose effect against six common mycotoxins: aflatoxin B1, deoxynivalenol, zearalenone, T-2 toxin, ochratoxin A and fumonisin B1. The mycotoxins were included at a level associated with the risk posed in feed as a model for commercial situations.

The results clearly showed this curvilinear effect on binding ability (Fig. 2). All the products tested were effective at binding the mycotoxins used, though some were significantly better than others. The study was clearly able to differentiate between products.

Increasing the dose of binder from 0.5-2.5g/kg resulted in an increase of toxins bound by around 65% on average (range 25-100%) not 500%, as might have been expected on a linear response. Doubling the dose of binder again to 10 times the original level resulted in a further 26% increase in binding on average (range 6-42%).

So, while increasing binder inclusion rate will result in more toxins being bound, the response in all cases is less than might have been anticipated.

Furthermore, taking the lowest dose of the top performing product (J) as the 100% reference, it can be seen that some products, even at the highest dose (10-fold the lowest dose) were not able to bind as much mycotoxin as Product J at the lowest dose. Therefore, choice of binder is critical to avoid excessive feeding and taking up valuable space within the diet. Even at very high inclusions, some products are not as good as others at much lower levels.

Mycotoxin binders are effective but it is misguided to assume that they are all the same, equally effective and that their use can eliminate the threat posed by the ubiquitous toxins. Careful selection of a binder is needed to ensure it is capable of binding mycotoxins effectively at a low dose. ■

References are available
from the author on request